Defining Composite Critical Scenarios for the Development of Large Scale System Architecture Using an SEI's ADD-based Framework

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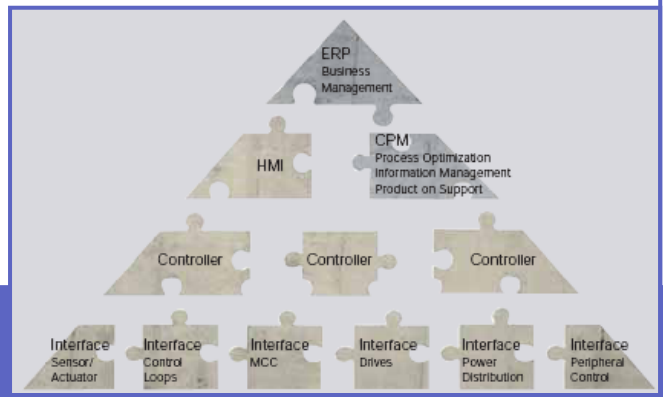

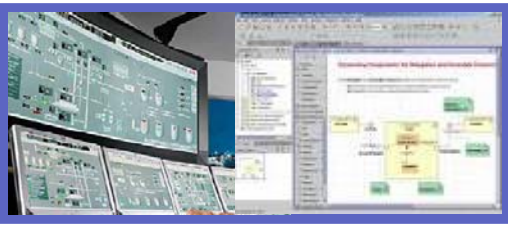

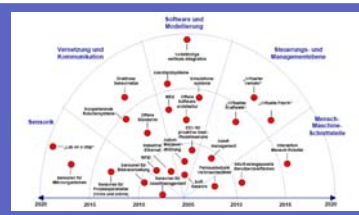

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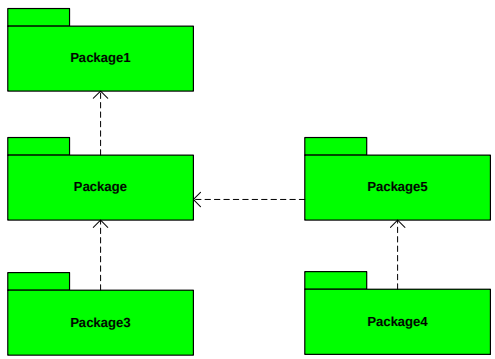
Attribute Driven Design (ADD)

- ADD is a methodology used to define a system architecture that bases the decomposition process on the quality attributes the system (software) has to fulfill.
- The architectural design using the ADD methodology can begin when the architectural drivers are known with some level of confidence.
- In ADD Tactics and Architectural patterns are selected to satisfy a set of quality attributes within a critical scenario that provides context for those quality attributes



Steps for Creating a Software Architecture

Define Business Case for the System

This step allows to define the main business drivers and hence set priorities

Understand the Requirements

The functionality of the system and its quality attributes are the source of functional and non-functional requirements, which are needed to define the architecture

Leveraging Quality Attribute Scenarios

Encapsulate functional, non-functional requirements, and constraints into scenarios used to evaluate architecture options

Creating the Architecture Option(s)

The functionality of the system and its quality attributes are the source of functional and non-functional requirements, which are needed to define the architecture

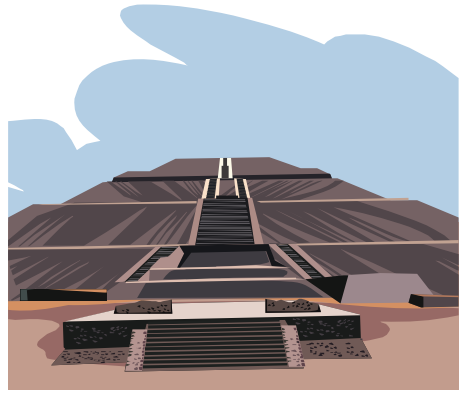
Documenting and Communicating Architecture Options

Analyzing or Evaluating the Architecture Options

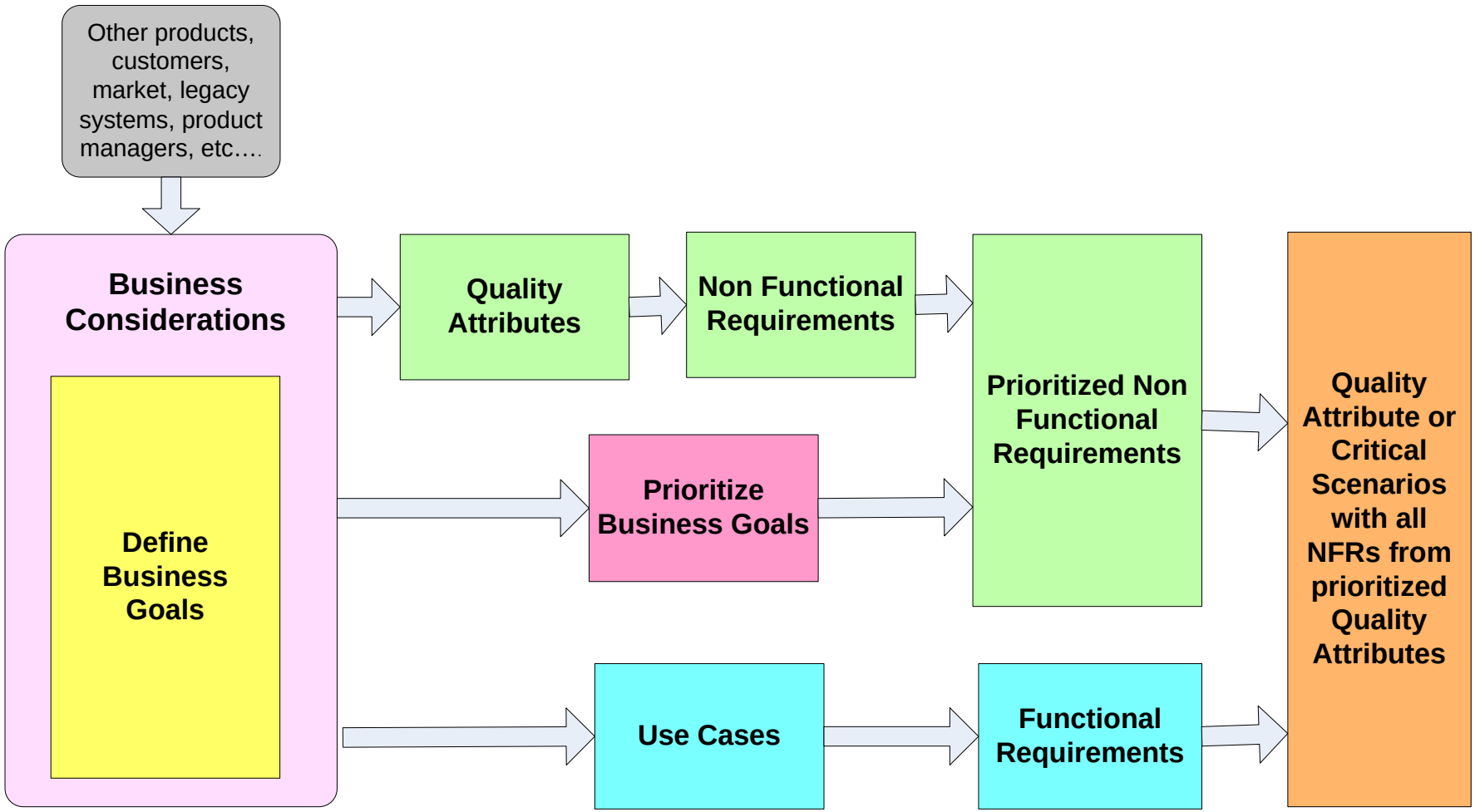
Evaluating architecture options for the qualities it supports

Implementing the Systems Based on the Architecture

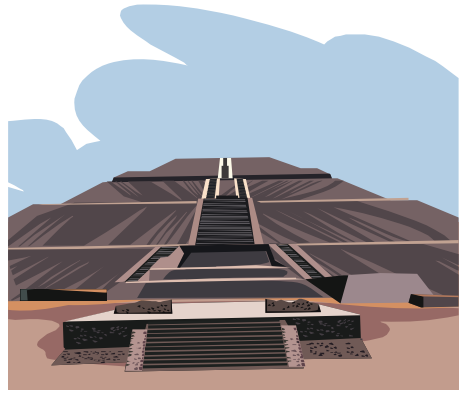
Ensuring that the Implementation Conforms to the Architecture



Prioritizing Business Goals



Define Business Case



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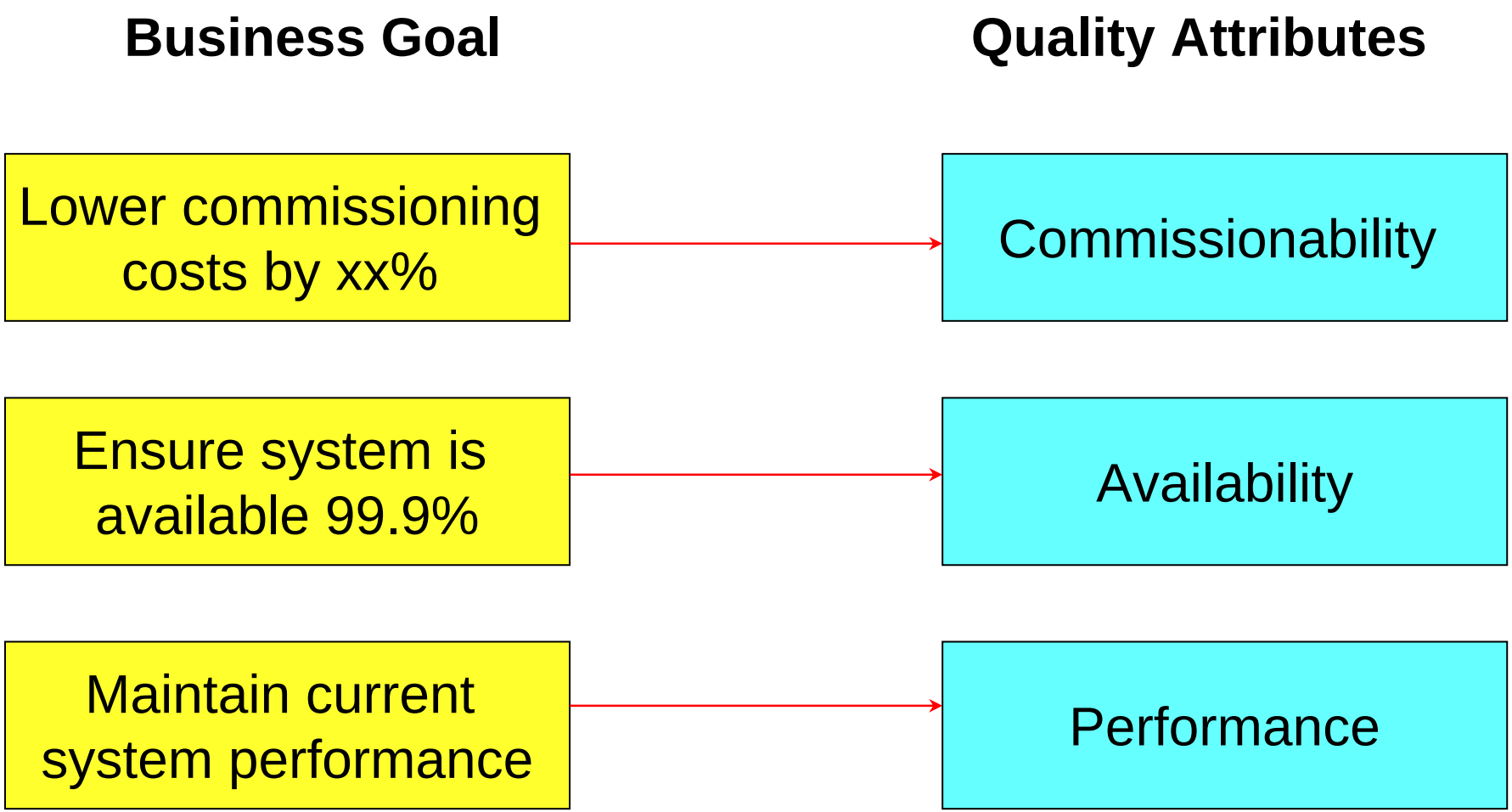
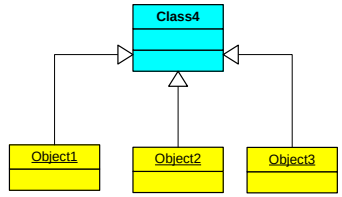
Business Goals

- **Prioritized Business Goals**
  - Business goals associated with the project are elicited from selected project stakeholders
  - Business goals are prioritized for stakeholders to guide architectural tradeoffs
- **Example of prioritized business goals:**
  - Lower commissioning costs by 30%
  - Ensure system is available 99.99%
  - Maintain current system performance

Mapping Business Goals and Quality Attributes

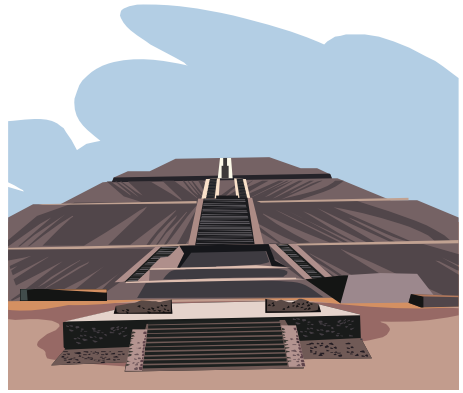


Business Goals and Quality Attributes



Business Goals	Software Qualities
Lower commissioning (customization, installation, and configuration) and recurring system setup costs by xx% in new System	**Commissionability**
Ensure data integrity in system	**Data Integrity**
Ensure System is available 99.99%	**Availability**
Maintain current system performance	**Performance**

Understand Requirements



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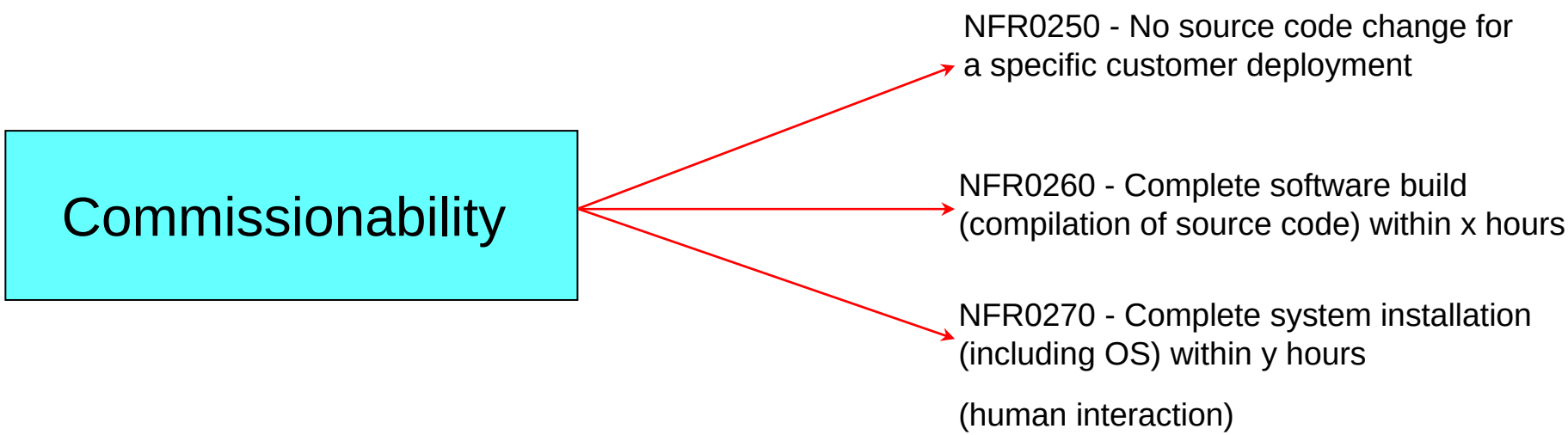
Develop Non-Functional Requirements

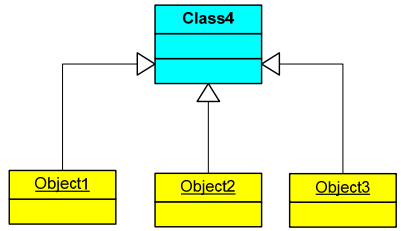
Quality Attribute
System Quality

Customer-related Non Functional Requirements
Associated/derived from Quality Attribute



Quality Attributes and Non-Functional Requirements

Business Goals	Driving Non-Functional Requirements	Software Qualities
Lower commissioning (customization, installation, and configuration) and recurring system setup costs by xx% for new system	NFR0250 - No source code change for a specific customer deployment NFR0260 - Complete software build (compilation of source code) within x hours NFR0270 - Complete system installation (including OS) within y hours (human interaction)	Commissionability
Ensure 100% data integrity in system	NFR0110 - Ensure data integrity across integrated systems NFR0100 - Provide controlled access to its data stores NFR0030 - Prevent data corruption and data loss	Data Integrity
Ensure system is available 99.9%	NFR0750 - Be available 24*7 (RFPs: 99.9%) NFR0720 - Failover for XXX and YYY functions shall be completed within xx seconds NFR0630 - The architecture must support hot failover NFR0740 - Loose coupling of components NFR0700 - Complete cold startup (from power-off condition) shall be completed with all functions scheduled for execution within xx time	Availability
Maintain current system performance	NFR0820 - Events processing speed NFR0870 - Display update upon change max exec time is xx sec NFR0030 - Prevent data corruption and data loss NFR0890 - Process events NFR0910 - Execution time of applications NFR0900 - Time to run sequence of applications from Topology Processing to Contingency Analysis NFR0860 - Supervisory control max execution time is 1 sec NFR0920 - CPU and memory consumption of applications	Performance



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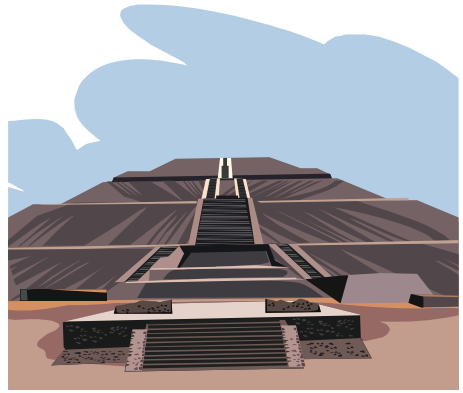
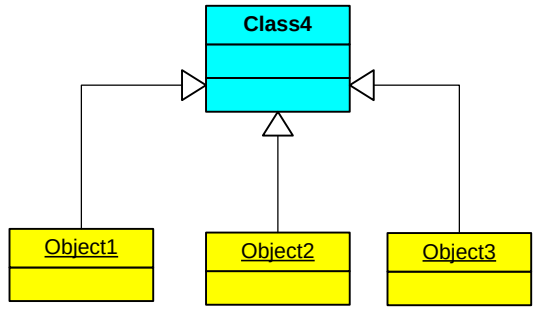
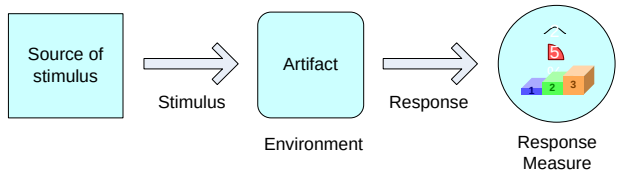


Architectural Drivers

- Architectural drivers (quality attribute scenarios) include the combination of functional and quality requirements that shape the architecture:
  - Define unique functions (as architectural Functional Requirements) of modules in the system
  - Select associated Non-functional Requirements
  - Quality Attributes or Critical System Scenarios provide the functional context under which Non Functional Requirements are defined
  - Architectural patterns that satisfy the critical scenarios are then selected

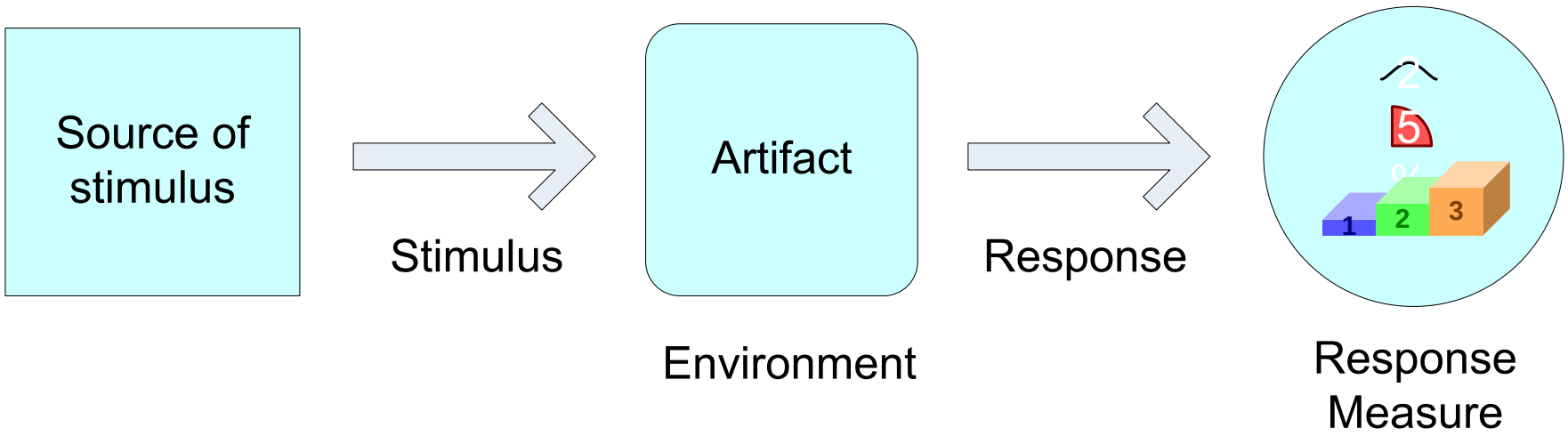


Quality Attribute Scenarios

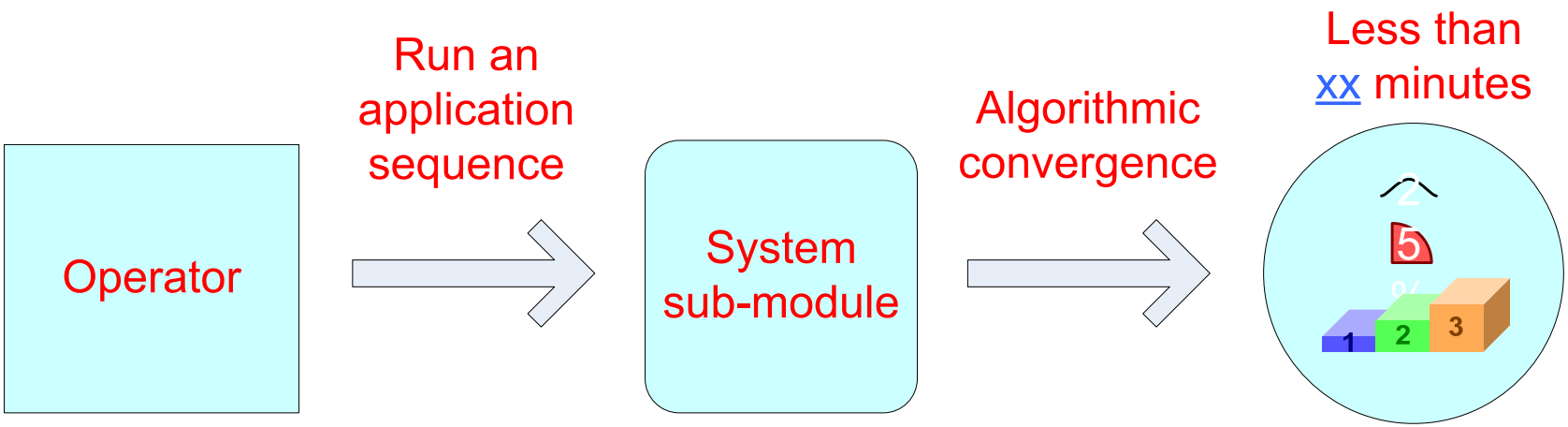


- **Encapsulate a set of architectural functional and non-functional requirements that uniquely define the system being architected**
- **Are described by a set of detailed architectural product requirements**
- **Can incorporate of one or more Use Cases**

Quality Attribute Scenario Elements



Quality Attribute Scenario: Run a Sequence of Applications

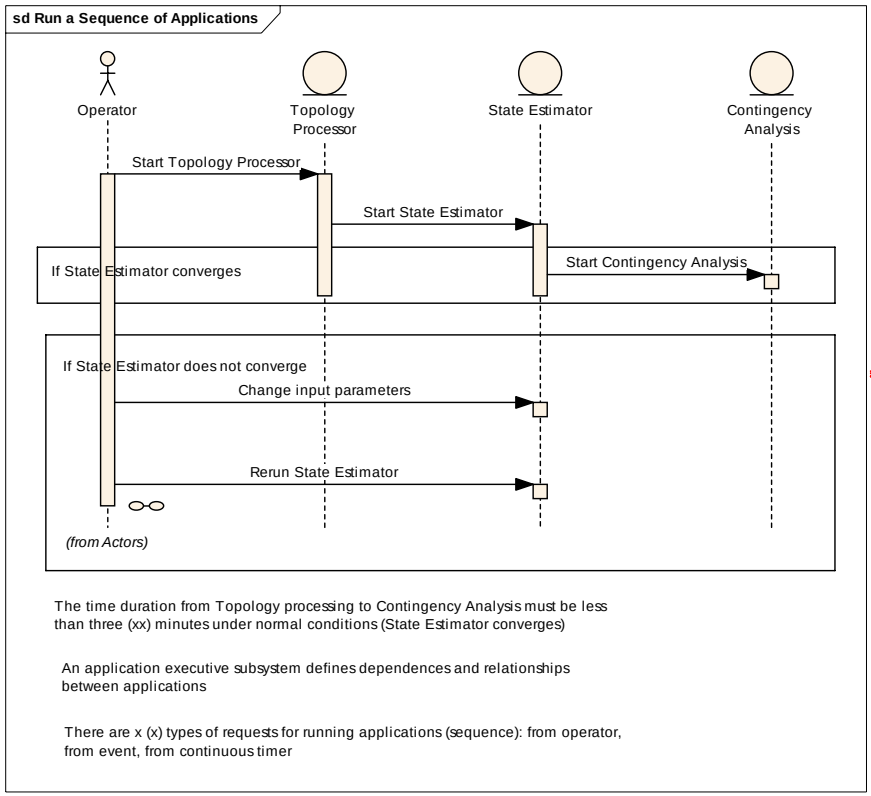


Source of stimulus	Stimulus	Environment	Response	Response Measure

Develop Critical System Scenarios

Critical Scenario

The operator runs a sequence of complex applications



Customer (Architectural) Requirements

Includes Functional and Non-functional requirements (and any constraints)

The system shall allow the operator to run the state estimator application

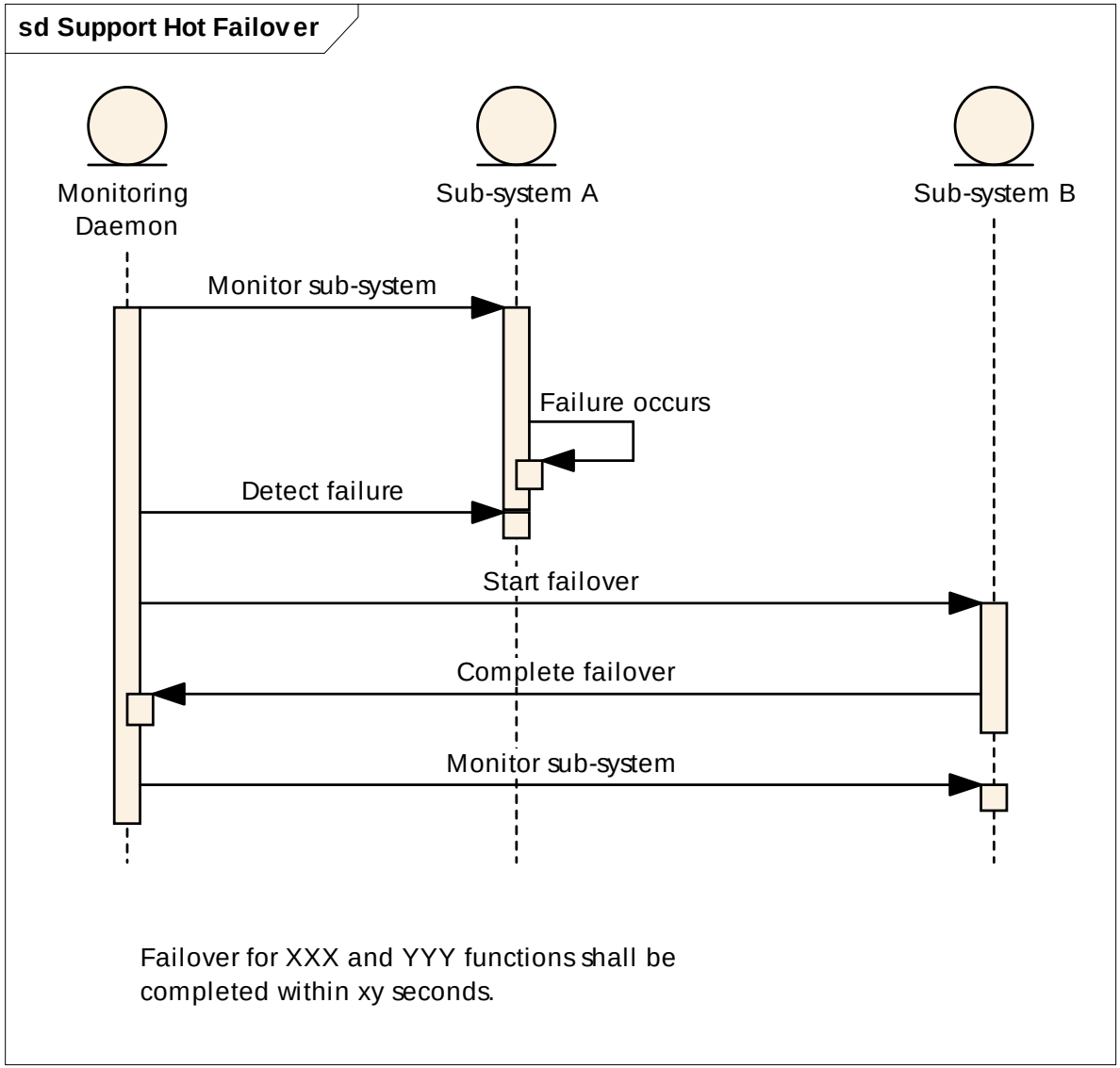
The system shall allow the operator to run sensitivity analyses

The system shall allow the operator to run the PS model

The system shall allow the operator to run a sequence of applications in an "industry acceptable" time

etc . . .

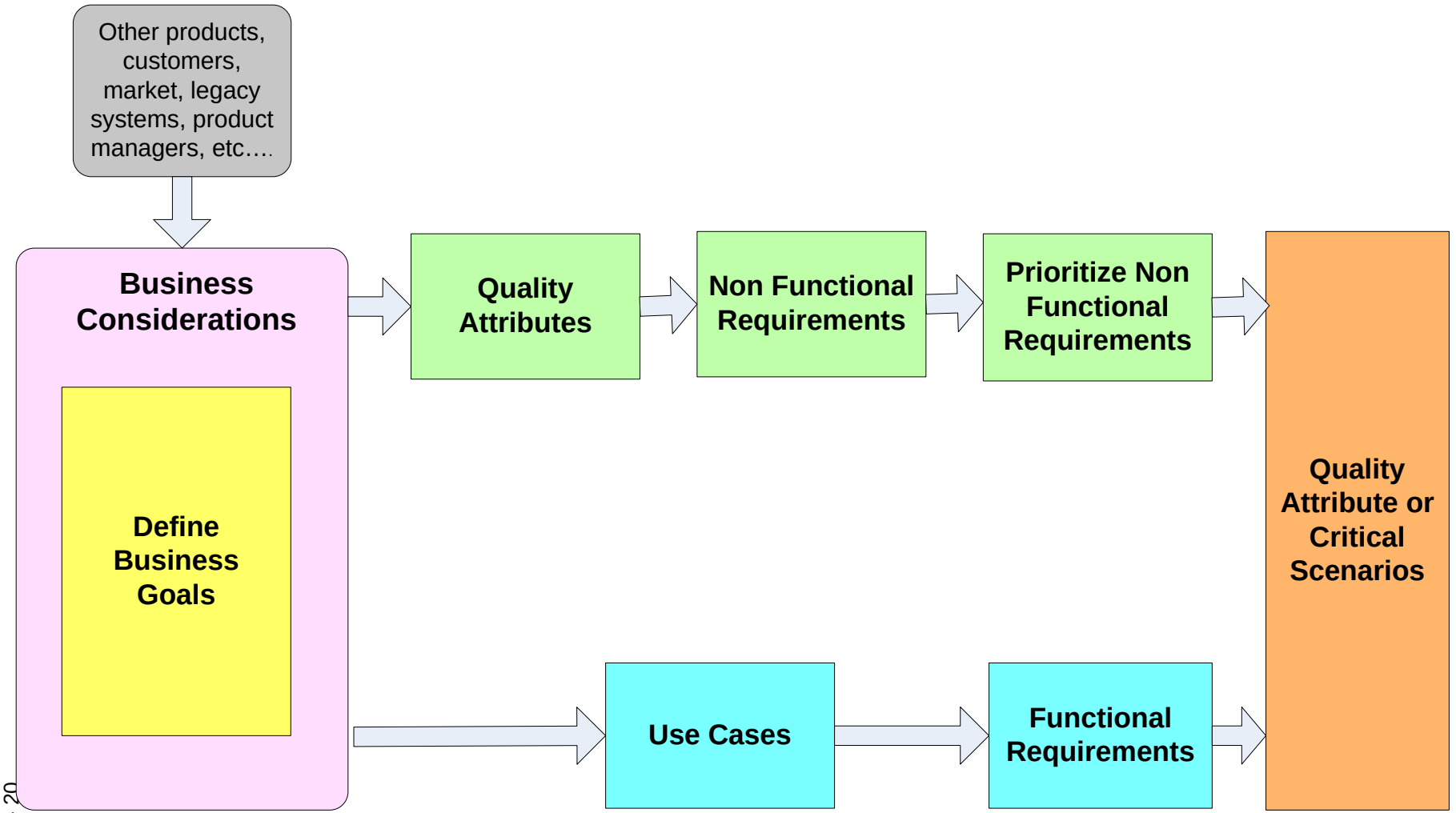
Another Critical System Scenario



Critical System Scenarios

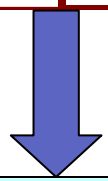
- Add new element and sub-elements to the system
- Integrate with external systems
- Process and display events
- Run advanced numerical applications
- Support hot-failover
- Run a sequence of complex applications

Prioritizing Non-Functional Requirements



Prioritized Non-functional Requirements

ID	Requirement	Calculated Avg.	Impact on Architecture	Prototype Importance	10*CalcAvg +ImpactArch
4.2.1.1	The new system will have one code base to ensure the functionalities of XXX system by using common technology and programming language, as well as shared or reusable modules.	5.0	5	5	55
4.2.4.1	The new system will have consistent mechanisms for integration with other components of overall system.	5.0	5	3	55
4.6.1.1	The failover of a server component using a backup database completes in no more than xx seconds.	5.0	5	1	55
4.3.3.2	The system allows the user to perform only the authorized actions.	5.0	5	1	55
4.2.5.4	The implementation plan shall facilitate the transition of the XXX team to the new development environment.	5.0	5	0.1	55
4.2.1.2	The impact of changes will be minimized in the new system thanks to a modular design	5.0	3	3	53
4.1.3.2	Shortcuts to achieve multi-row operations are available (aggregated data). Mass-update.	5.0	3	3	53
4.2.4.2	The new system will allow for interactive exchange of data between new YYY module and ZZZ module (messaging layer).	4.7	5	5	52
4.4.1.3	Dialog response time is less than x seconds in average and never more than y seconds.	4.7	5	5	52



Develop Quality Scenarios Using Prioritized NFRs

Observations

- It is easier for Senior Management to prioritize Business Drivers than non functional requirements
- Creation of Composite Scenarios provides a richer approach to prototype architectural options
- Prioritization of business goals automatically prioritizes qualities and non functional requirements
- Potential for missing important non functional requirements that fall outside the prioritization scheme
- Analysis may become more complex using Composite Scenarios

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